

Claims

- [c1] A method of forming an interconnect structure comprising the steps of:
- providing a lower electrical contact including a lower interconnect member;
 - depositing an ILD and forming an interconnect aperture therein extending down to make contact with said lower interconnect member;
 - depositing a liner layer in said aperture;
 - removing said liner layer on at least the bottom surface of said aperture, thereby exposing a top surface of said lower interconnect member;
 - removing material from the interface of said lower interconnect member and the bottom surface of said aperture, thereby forming a second aperture within said lower interconnect member; and
 - depositing conductive material in said interconnect aperture, thereby establishing a joint between said lower interconnect member and an upper interconnect member formed by said conductive material in said interconnect aperture.
- [c2] A method according to claim 1, further comprising:

removing said liner layer on horizontal surfaces of said interconnect aperture, including said bottom surface of said aperture; and
said step of removing material from said lower interconnect member removes material in a shape having substantially no horizontal surfaces;
depositing a second liner layer on horizontal surfaces of said interconnect aperture.

- [c3] A method according to claim 1, in which the material of said lower interconnect member is selected from the group comprising Cu, W, Al, and other conducting materials.
- [c4] A method according to claim 1, in which the material of said first and second liners deposited on the dielectric structure are selected from the group comprising TaN, Ta, Ti, Ti(Si)N and W.
- [c5] The method of claim 1, wherein the gas for ion bombardment is selected from the group comprising Ar, He, Ne, Xe, N_2 , H_2 , NH_3 , N_2H_2 .
- [c6] A method according to claim 1, in which said step of removing material from said lower interconnect member removes said material in a generally cone shape having a height greater than the radius.

- [c7] A method according to claim 2, in which said step of removing material from said lower interconnect member removes said material in a generally cone shape having a height greater than the radius.
- [c8] A method according to claim 1, in which said step of removing material from said lower interconnect member removes said material in a generally cone shape having a height greater than or equal to $(3)^{0.5}$ times a radius.
- [c9] A method according to claim 2, in which said step of removing material from said lower interconnect member removes said material in a generally cone shape having a height greater than or equal to $(3)^{0.5}$ times a radius.
- [c10] A method according to claim 3, in which said step of removing material from said lower interconnect member removes said material in a generally cone shape having a height greater than or equal to $(3)^{0.5}$ times a radius.
- [c11] A method according to claim 1, in which said step of removing said liner layer on the bottom surface of said aperture comprises simultaneously performing an ion bombardment and an in-situ material deposition.
- [c12] A method of forming an interconnect structure comprising the steps of:

providing a lower electrical contact including a lower interconnect member covered by a cap layer;
depositing an ILD and forming an interconnect aperture therein extending down to make contact with said cap layer on said lower interconnect member;
depositing a liner layer in said aperture;
removing said liner layer on at least the bottom surface of said aperture, thereby exposing a top surface of said cap layer;
removing material from the interface of said lower interconnect member and the bottom surface of said aperture, thereby forming a second aperture within said lower interconnect member; and
depositing conductive material in said interconnect aperture, thereby establishing a joint between said lower interconnect member and an upper interconnect member formed by said conductive material in said interconnect aperture.

- [c13] A method according to claim 12, further comprising:
removing said liner layer on horizontal surfaces of said interconnect aperture, including said bottom surface of said aperture; and
said step of removing material from said lower interconnect member removes material in a shape having substantially no horizontal surfaces;

depositing a second liner layer on horizontal surfaces of said interconnect aperture.

- [c14] A method according to claim 12, in which the material of said lower interconnect member is selected from the group comprising Cu, W, Al, and other conducting materials.
- [c15] A method according to claim 12, in which the material of said first and second liners deposited on the dielectric structure are selected from the group comprising TaN, Ta, Ti, Ti(Si)N and W.
- [c16] The method of claim 12, wherein the gas for ion bombardment is selected from the group comprising Ar, He, Ne, Xe, N_2 , H_2 , NH_3 , N_2H_2 .
- [c17] A method according to claim 12, in which said step of removing material from said lower interconnect member removes said material in a generally cone shape having a height greater than the radius.
- [c18] A method according to claim 12, in which said step of removing material from said lower interconnect member removes said material in a generally cone shape having a height greater than or equal to $(3)^{0.5}$ times the radius.
- [c19] An interconnect structure in an integrated circuit com-

prising:

a lower electrical contact including a lower interconnect member;

an ILD having an interconnect aperture formed therein extending down to make contact with said lower interconnect member;

a liner layer formed on sides of said aperture;

an upper interconnect member formed in said interconnect aperture and making contact with said lower interconnect member, said contact extending down into said lower interconnect member.

[c20] A structure according to claim 19, in which said contact is a generally cone shape having a height greater than the radius.

[c21] A structure according to claim 20, in which said contact is a generally cone shape having a height greater than or equal to $(3)^{0.5}$ times the radius.

[c22] A structure according to claim 19, in which said interconnect aperture has a single liner layer on horizontal surfaces and a double liner layer on vertical surfaces.

[c23] A method according to claim 1, further comprising:
removing said liner layer on horizontal surfaces of said interconnect aperture, including said bottom surface of

said aperture; in which said step of removing material from said lower interconnect member removes material in a shape having substantially no horizontal surfaces; and
depositing a second liner layer on horizontal surfaces of said interconnect aperture, in which said second liner is not deposited on said shape in said lower interconnect member, whereby there is a direct contact between the material of said upper interconnect member and the material of said lower interconnect member.

[c24] A method according to claim 12, further comprising:
removing said liner layer on horizontal surfaces of said interconnect aperture, including said bottom surface of said aperture; in which said step of removing material from said lower interconnect member removes material in a shape having substantially no horizontal surfaces; and
depositing a second liner layer on horizontal surfaces of said interconnect aperture, in which said second liner is not deposited on said shape in said lower interconnect member, whereby there is a direct contact between the material of said upper interconnect member and the material of said lower interconnect member.